Sessions 1 and 2

Building Polygons

Materials

- Building kits (1 per pair)
- Building Kit Length Guide (1 per pair)
- Student Sheet 2 (1 per pair)
- Overhead projector, transparency
- Student Sheet 3 (1 per pair)
- Student Sheet 4 (1 per pair)
- Student Sheet 5 (1 per student, homework)

What Happens

Students build polygons such as triangles, squares, and rectangles. They reflect on the components of the figures and relationships between those components. They investigate the properties of triangles, squares, and rectangles. Their work focuses on:

- finding the number of sides and corners in polygons
- investigating relationships between lengths of sides of polygons

Ten-Minute Math: Quick Images Two or three times during this investigation, do the Quick Images activity. Ten-Minute Math activities are intended to be done outside of math class, during any spare ten minutes you have during the day.

Choose a design cut from the Quick Image Geometric Designs transparency (p. 103). Students will need only paper and pencil. Show the design on the overhead projector for 3 seconds. Students try to draw the image and figure out how it is put together.

Show the design for another 3 seconds, and let students revise their drawings. Then reveal the design for final comparisons. Ask students to describe how they saw the image on successive flashes.

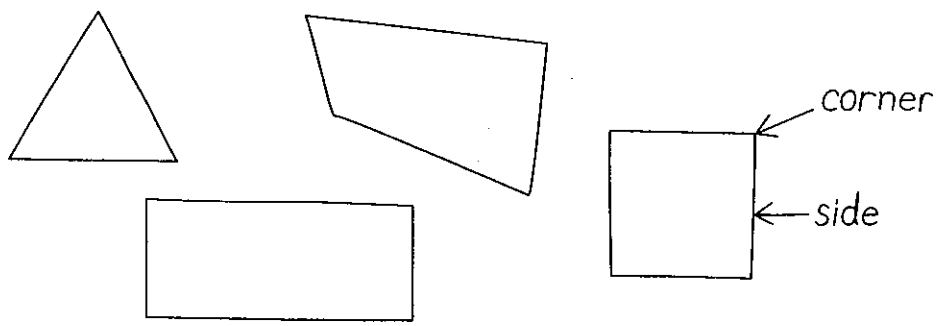
For full directions and variations, see p. 63.

Activity

Building the Polygons

We're going to build some familiar shapes such as triangles, squares, and rectangles. These shapes are called *polygons.*

As you introduce this activity, draw some examples on the board.



We'll call the "straight parts" of a polygon *sides* and the "pointy parts" where the sides come together *corners.* [*Point to a few examples of sides and corners.*] **Who can show me a side and a corner for this rectangle?**

Distribute a set of building materials, a Building Kit Length Guide, and Student Sheets 2 and 3, Building Triangles and Building Squares, to each pair of students. Students will share these materials throughout this investigation.

Demonstrate how to build a polygon with the sticks and connectors you have assembled for the kits.

Students build the polygons and solve the problems on Student Sheets 2 and 3. Generally, they will have to take apart one figure before building another. Students draw each polygon that they make, labeling the sides appropriately. See the **Teacher Note,** Naming Sticks (p. 20), for a discussion of how students can refer to the different lengths of sticks as they talk and write about them.

It is important to have a whole-class discussion of student work on the same day students complete a given student sheet. (See the next activity for discussion suggestions.) It usually takes about one session for students to complete both Student Sheet 2 (the triangles) and Student Sheet 3 (the squares), allowing for a 15-minute follow-up class discussion. The class can then move on to Student Sheet 4, Building Rectangles, with a follow-up discussion of that work as they finish it.

The optional problems on Student Sheets 2 and 4 make good extension activities (see p. 19).

Activity

Discussing the Polygons

Triangles

In discussing Student Sheet 2, Building Triangles, encourage students to draw on the overhead or hold up their constructed triangles.

For problem 1, do students notice that although their triangles may be different sizes, all are the same shape? Place two such similar but different-sized triangles on top of each other to illustrate this. As one student observed, "The corners are the same—the sides are just bigger."

Then discuss problem 3:

Show me three sticks that did not make a triangle. Why don't these sticks make a triangle?

Students will likely say things such as, "You can't have two short ones [sticks] and one that's much longer." This is true. If one stick is longer than the sum of the lengths of the other two, a triangle cannot be made.

Encourage students to think more generally about this issue.

Will *every* three sticks make a triangle?

Squares

As students complete their work on Student Sheet 3, Building Squares, ask questions that will help them focus on the properties of squares.

How many sticks did you use for each square?
What did you notice about the lengths of the sides of a square?
Can you build a square with one 6-inch, one 5-inch, one 4-inch, and one 3-inch stick? Why or why not?

Did students discover that a square can be made only by using four sticks of the same length?

❖ **Tip for the Linguistically Diverse Classroom** Students with limited English proficiency could draw or demonstrate to you their answers to item 2 on both Student Sheets 3 and 4.

Rectangles

In your discussion of their work on Student Sheet 4, Building Rectangles, help students focus on the properties of rectangles with questions like these:

How many sides are there in each rectangle? What do you notice about the lengths of the sides of these rectangles?
Can you build a rectangle with two 3-inch sticks, one 5-inch stick, and one 6-inch stick? Why or why not?

Did students discover that a rectangle can be made only from two pairs of same-length sticks?

Sessions 1 and 2 Follow-Up

Homework

Finding Polygons at Home Students find polygons at home, paying close attention to length of sides. They record the shapes they find on Student Sheet 5, Finding Polygons at Home. Note that unlike the shapes students found for Student Sheet 1, Identifying Geometric Shapes in the Real World, these shapes will be two-dimensional (such as a rectangle on the surface of a brick wall.)

Extension

Polygon Challenges For the optional problem on Student Sheet 2, there is only one triangle that can be built using one 5-inch, one 6-inch, and one 8-inch stick, although there are many different orientations for this triangle. For the optional problem on Student Sheet 4, there are an infinite number of four-sided polygons that can be built by using one 6-inch, one 5-inch, one 8-inch, and one 4-inch stick. Different four-sided polygons can be obtained by changing the order of the sticks. But even with a given order of sticks, an infinite number of different shapes can be obtained by changing the angles of the shape. (This cannot be done with triangles. That is why triangles are called "rigid figures," and why triangles are used to brace many structures.)

An issue that often comes up with these activities is how to decide whether two shapes are the same. Mathematicians consider two figures to be the same if they have exactly the same shape, no matter how they are oriented. Many students do not accept this convention, and believe that two copies of the same figure are different if they are oriented differently. The **Dialogue Box,** Are They the Same? (p. 21) provides an example of how one teacher handled this issue with her students.

Name Date

Student Sheet 2

Building Triangles

Build the triangles described below. Draw a picture of each triangle you build. Label the length of each stick you use.

1. Make a triangle with all sides the same length.

2. Make a triangle with all sides different lengths.

3. Can you find three sticks that will **not** make a triangle? If you can, draw them. Label them to show their lengths. Why won't these sticks make a triangle?

Optional

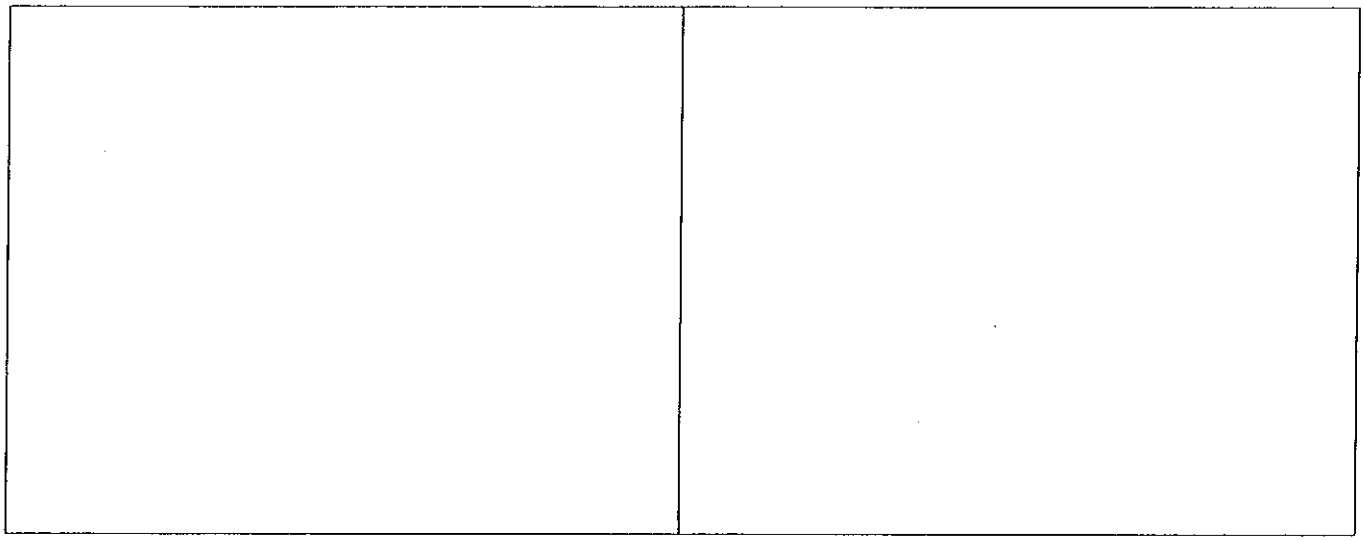
How many different triangles can you build using one 5-inch stick, one 6-inch stick, and one 8-inch stick? Draw them on the back of this sheet.

Name Date

Student Sheet 3

Building Squares

1. Build two different squares. Draw a picture of each square. Label the length of each side.



2. Can you build a square with one 6-inch stick, one 5-inch stick, one 4-inch stick, and one 3-inch stick? Why or why not?

Building Rectangles

1. Build three different rectangles. Draw a picture of each rectangle. Label the lengths of the sides.

2. Can you build a rectangle with one 5-inch stick, one 6-inch stick, and two 3-inch sticks? Why or why not?

Optional

How many different four-sided polygons can you build using one 8-inch stick, one 6-inch stick, one 5-inch stick, and one 4-inch stick? Draw some of them on the back of this sheet. Be sure to label the lengths of the sides.